BPT25-01 Room:202 Time:May 24 14:15-14:30

Stem and crown evolution: United grand theory of life evolution

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Evolutional theories have long been discussed since 19th century. One of the most famous theory of evolution was proposed by Darwin about 150 years ago. Since then, Gould's punctuated equilibrium theory, Kimura's neutral evolution etc were proposed and recently molecular biology is rapidly developing. However, there is discrepancies in proposed phylogenic trees due to theoretical differences to analyze. So, we tried to implicate the evolution of history from synthetic paleogeographic map based on geological evidences including fossil data.

As a result, we propose there are two significant patterns of evolution through Earth history. One is stem evolution which occur at continental rift where atomic bomb magma erupt to accelerate the birth of new species by mutation. The other pattern is crown evolution that progress when continents collide after species were evolved in isolated environment such as places on fragmented continents. At the same time of those patterns of evolution, fluctuation happened in the Universe five huge impact on life history which is mass extinction. Activities such as starburst and collision between solar system and a dark nebula was the trigger to cause mass extinction and subsequent rebirth of another ecosystem on the Earth.

BPT25-02 Room:202 Time:May 24 14:30-14:45

What is main marine primary producer during the Cretaceous OAEs?: Evidences from marine kerogens.

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The mid-Cretaceous oceanic anoxic events (OAEs) are important to understand extremely greenhouse world. It is thought that enhanced marine productivity caused the global anoxia, although coccolithophorid and dinoflagellate productivity were diminished during the OAEs. Distinct algal biomarkers such as 2-methyl hopanoid and isorenieratane in the OAE levels indicate high activities of cyanobacteria and green sulfur bacteria, although detection of these biomarkers was limited. Amorphous organic matter (AOM) and very small palynomorph such as acritarchs are main components of OM in black shale but they were removed at the time of palynomorph analysis with size fractionation. In the present study, we analyzed kerogen including AOM and small acritarchs by fluorescent microscope and pyrolysis/thermochemolysis method to reconstruct variation in primary producers during OAEs.

Black shales were collected from the Goguel (OAE1a), Jacob, Kilian, Paquier (OAE1b), Breistroffer (OAE1d) and Thomel (OAE2) levels in SE France. These crushed samples were extracted with ultrasonication and their residues were sequentially treated by acids in a water bath shaker (Sawada et al., 2012). AOM classified into NFA (non-fluorescent AOM; wood origin), WFA (weakly fluorescent AOM; marine plankton origin) and FA (fluorescent AOM; cuticle or palynomorph origin), and acritarchs divided into five groups (sphaeromorph, pteromorph, acanthomorph, netromorph, polygonomorph). We analyzed pyrolysis and thermochemolysis of kerogen by using GC-MS equipped a Curie-point pyrolyzer.

Kerogens in the Goguel (OAE1a) samples are mainly comprised of WFA, and percentages of WFA (WFA%) are slightly higher in black shale samples. Green algal phycoma-like acritarchs, sphaeromorph, are abundant in the Goguel level, especially acme phase of OAE1a. Anoxia during the OAE1a might be related to high production of green algae. Terrestrial NFA are main components in all OAE1b samples, although WFA are higher in black shale samples of the Kilian and Paquier levels. These data show both enhanced marine production and excess terrestrial input led anoxia during the OAE1b. Sphaeromorph are also observed from black shales samples of OAE1b level s. In addition, percentages of long-spine type acanthomorph are higher in the Paquier level. The WFA% values are remarkably higher in the OAE1d and 2 samples, especially black shales of OAE2 (80-90%), which suggest that enhanced productivity during the OAE1d and OAE2. Netromorph, which has each spine in bipolar, is observed in only OAE1d samples. Sphaeromorph decrease but acanthomorph increase with decreasing WFA% values in the Trough interval (cooling phase) of the OAE2 level. 2-methyl hopane and a large amount of branched alkanes are detected by pyrolysis/thermochemolysis analysis from the OAE1a and OAE1b samples, respectively. These pyrolysis results are consistent with those of free biomarkers. Branched alkanes were characteristically detected as pyrolysate of WFA in accumulated layers of the Paquier level, and the relative abundances of these compounds correlated with free tail-to-tail isoprenoid concentration. These tail-to-tail isoprenoids are presumably derived from lycopanoid skeleton of marine phytoplankton such as green algae, which is supported by the results of kerogen.

Keywords: Oceanic Anoxic Events (OAEs), kerogen, acritarch, palynofacies, pyrolysis, thermochemolysis

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Paleotemperature, productivity and shell size of Hedbergella delrioensis in the Cretaceous thermal maximum

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Planktic foraminifers, experienced two major diversity crises at the Cretaceous/Paleogene boundary and the Eocene/Oligocene boundary, have emerged in late Jurassic and repeatedly flourished in these 100 myr Earth history (e.g. Norris, 1991). Among them, the Cretaceous foraminifers diversified in the greenhouse interval. Morphologies of some Cretaceous species are very unique, and never reappeared after the K/Pg boundary (Norris, 1991). Its diversity has widely been discussed in relation with oceanic anoxic events in the mid-Cretaceous (e.g. Leckie et al., 2002).

On the other hand, size distribution within a modern planktic foraminiferal community, and intra-species size variation are known to respond to abiotic properties, such as temperature and salinity, and productivity (Bijma et al., 1990a, 1990b; Schmidt et al., 2004). However, the size distribution of the Cretaceous foraminifers has not been widely analyzed so far. We discuss the intra-species size variation of the mid-Cretaceous planktic foraminifer, *Hedbergella delrioensis*, and environmental qualities; paleotemperature, salinity and productivity.

Pelagic sediments used for this study were recovered in ODP Leg 207 at Demerara Rise, the equatorial Atlantic. Samples were washed through a sieve with 64μm opening. Approximately 100 individuals of *H. delrioensis* were picked from particles larger than 125 μm. The largest linear dimension of each individual was measured, and the stratigraphic variation of average size was described. Since TEX$_{86}$ and carbon and oxygen isotope composition of planktic foraminifers have already been analyzed by Forster et al. (2007) and Moriya et al., (2007), stratigraphic variations of these proxies were discussed with the size distribution. Average size of *H. delrioensis* co-varies with the productivity estimated from the carbon isotope composition. Considering that the paleotemperature and salinity had been unchanged in the interval analyzed, it is expected that the size of *H. delrioensis* responded to the local productivity.

Bijma, J. et al. (1990) Jour Foram Res. 20, 117-127.
Bijma, J. et al. (1990) Jour Foram Res. 20, 95-116.
Forster, A. et al. (2007) Geology. 35, 919-922.
Leckie, R. M., et al. (2002) Paleoceanography. 17, 10.1029/2001PA000623.
Moriya, K. et al. (2007) Geology. 35, 615-618.
Norris, R. D. (1991) Paleobiology. 17, 388-399.
Schmidt, D. N. et al. (2004) Mar Micropaleontol. 50, 319-338.

Keywords: Cretaceous, planktic foraminifer, shell size, paleotemperature, productivity

BPT25-04 Room:202 Time:May 24 15:00-15:15

Durophagous predation on scaphitid ammonoids in the Late Cretaceous Western Interior Seaway of North America

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The study of the evolution of predator-prey interactions has contributed much to our understanding of the ecological background of biodiversity change through geological time, because they represent a driving force of natural selection. This study is the first to report a trend of predation intensity on scaphitid ammonoids from the Turonian to the Maastrichtian (Late Cretaceous) on the basis of analysis of ventral shell breakage in large samples from the U.S. Western Interior Province. Analysis of 835 adult specimens revealed ventral shell breakage in 50 specimens. In most of the damaged specimens, the breakage occurred in a preferred position at the rear part of the body chamber. Ventral breakage is rare in the Turonian specimens, whereas it is common in the Campanian and Maastrichtian specimens. The shell diameter of adult scaphitid ammonoids tends to increase with time. The position of the breakage and the absence of repairs indicate that the ventral breakage resulted from lethal predation. Based on the incidence of breakage and the size and shape of the breaks, possible predators include fish, reptiles, and cephalopods such as *Placenticeras*, *Eutrephoceras*, and coleoids. Our statistical analysis of ventral shell breakage indicates that the incidence of lethal predation increased in conjunction with an increase in adult shell size, suggesting that the body size of the prey was an important factor in predator?prey interactions. In addition, the predatory damage is more extensive in larger adults.

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Origin and rapid dispersal of oceanic dolphins (Odontoceti: Cetartiodactyla) based on the oldest fossil record.

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Oceanic dolphins (Delphinidae), such as killer whales, pilot whales and bottlenose dolphins, comprise approximately 36 extant species in 17 ˜19 genera, which makes them the most speciose group of cetaceans inhabiting the modern ocean. Despite their current diversity, the fossil record of delphinids is very limited, and it remains unclear how and when they first originated. Molecular clock analyses date the divergence of delphinids from other delphinoids (porpoises, belugas and narwhals) to the Early or Middle Miocene (about 23 ˜14 Ma). By contrast, the so far ”oldest” extinct taxon confidently referred to the group - *Eodelphinus kabatensis* from Hokkaido - is no older than Late Miocene (about 9 Ma). Thus, there is a considerable gap between the estimated time of origin as inferred from molecular data and the fossil record, respectively.

Here, we re-examine the extinct dolphin *Sinanodelphis izumidaensis* Makiyama, 1936, which is known from a relatively well-preserved skull and associated partial skeleton from the Middle Miocene Bessho Formation (approximately 13. 6˜11. 8 Ma), Nagano Prefecture, central Japan. Although initially described as a delphinid, later studies classified this species as Delphinoidea *incertae sedis* because of a lack of diagnostic characters and the incomplete preparation and limited accessibility of the holotype (the latter has been designated as a Natural Monument of Nagano Prefecture). For our analysis, we studied both the holotype (via direct observation and CT scanning) and two undescribed specimens (previously reported as Delphinoidea fam., gen. et sp. indet.) that were recovered from nearly the same locality and horizon. All of the specimens are similar in terms of general skull proportions, in having numerous, small teeth, and in having markedly asymmetrical external bony nares, indicating that they likely belong to the same species.

We performed phylogenetic analysis based on 84 species (all odontocetes) and 278 morphological characters, with the archaeocetes *Georgiacetus* and *Zygorhiza* used as out-group. Our results identify *S. izumidaensis* as one of the earliest diverging members of crown Delphinidae. This placement extends the fossil record of delphinids to ca. 14 ˜12 Ma, only slightly younger than - and therefore in agreement with - the youngest molecular divergence dates. A further, as yet undescribed fossil delphinid apparently also occurs in the Middle or Late Miocene (13. 6 ˜10. 3 Ma) of California. Together, *S. izumidaensis* and the Californian material demonstrate that delphinids may have inhabited both sides of the North Pacific as little as 1 Ma after their presumed time of origin. This, in turn, may be indicated that dolphins underwent a phase of rapid geographical dispersal early during their evolutionary history.

Keywords: Sinanodelphis izumidaensis, Delphinidae, Middle Miocene, Bessho and Aoki Formation

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Benthic-pelagic coupling in Pliocene ocean: Geochemical and micropaleontologic evidence in the ichnofossil Phymatoderma

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Numerous studies have revealed the evidence of benthic-pelagic coupling in various ocean areas. In terms of marine benthos, it is well known that feeding, growth and reproduction are generally synchronized with the seasonal input of phytodetritus to the sea-floor. However, compared to examples of modern organisms, little is known about the evidence of the ancient benthic-pelagic coupling. Thus, the present study carried out the geochemical and microscopic analyses of the fecal pellet-filled ichnofossil *Phymatoderma* from the Pliocene deep-sea strata. The aim of this study is to assess whether benthic-pelagic coupling functioned in the ancient ocean, with special attention to the temporal relationship between phytodetritus input and deposit feeding by the trace-maker. Elemental analysis revealed that Ca, which is probably derived from the calcareous microfossils, is significantly accumulated in the tuffaceous pellets. Because the CaO content of the pelletal infill are generally similar to that of the host siltstones, it may be concluded that the recognized Ca accumulation in pellets does not reflect diagenetic alteration. SEM observations showed the presence of various types of microfossils (i.e., coccoliths, diatoms, planktonic foraminifera, radiolaria) within the pelletal infill of *Phymatoderma*. In addition, excreted tuffaceous fecal pellets are occasionally found to be composed exclusively of coccoliths. Considering all these lines of evidence, it is most likely that the deposit-feeding by the *Phymatoderma*-producer was synchronized with an episodic (probably seasonal) coccolithophore bloom deposition on the deep-sea floor. The reconstructed feeding strategy may have facilitated the effective uptake of freshly deposited phytodetritus. This interpretation is quite reasonable because such a mode of feeding has been commonly recognized in the case of deep-sea deposit-feeding macro and megabenthos. In summary, this study provides geologic evidence for benthic-pelagic coupling in the Pliocene ocean.